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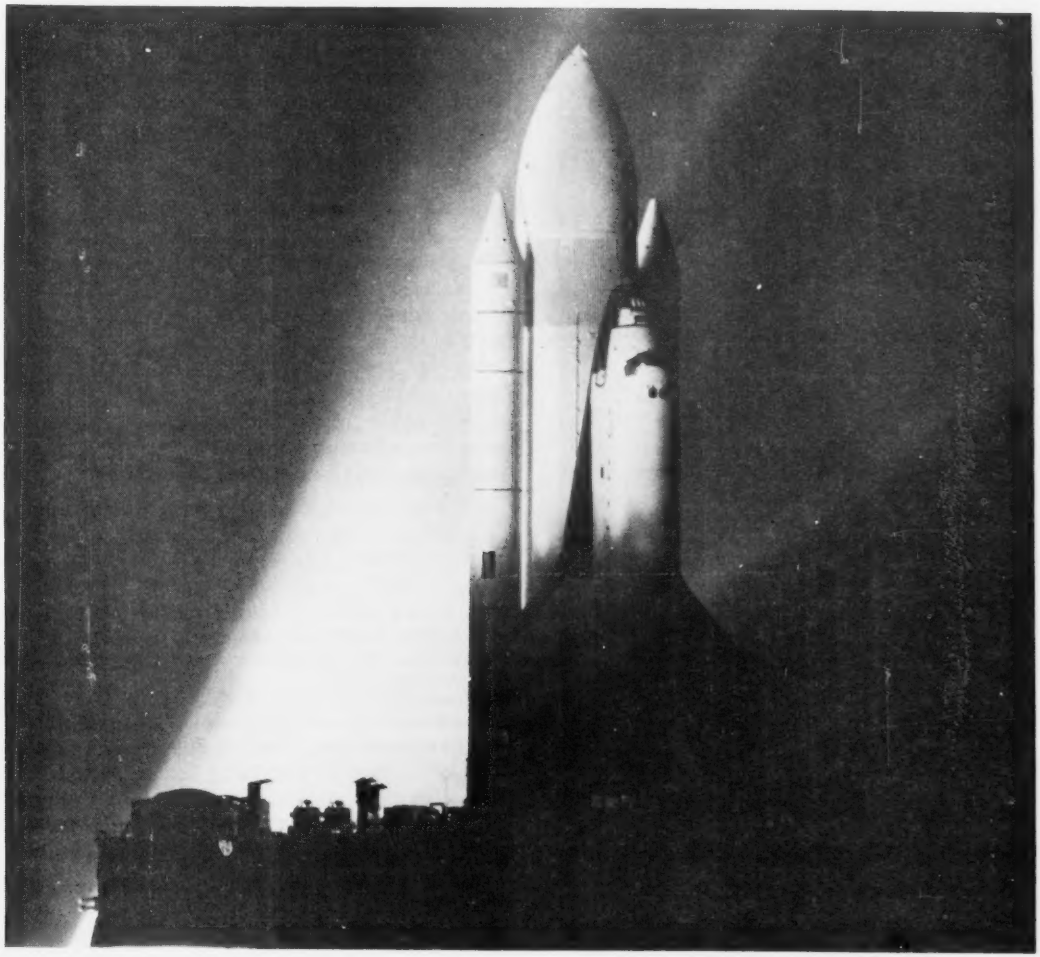
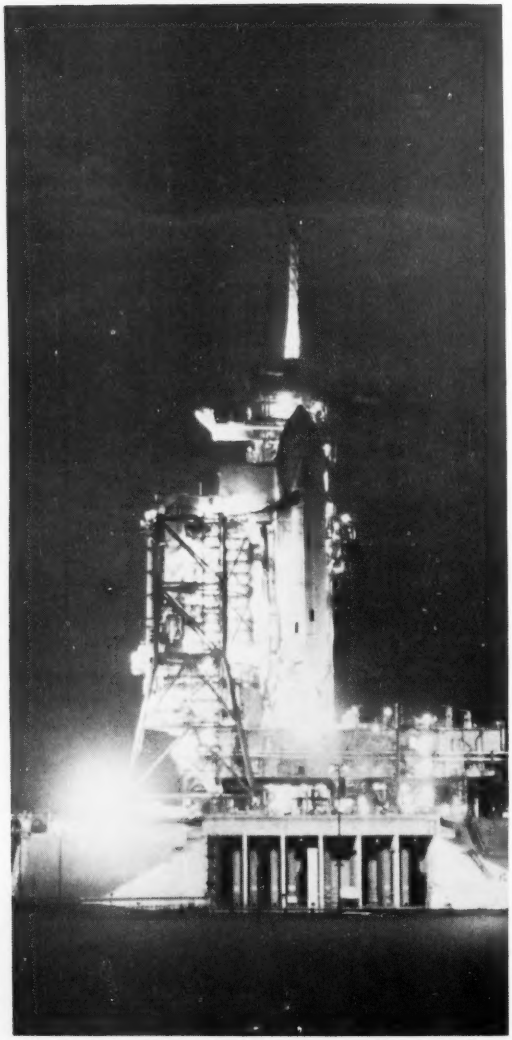


About the Cover

The Space Shuttle Columbia, mated with a new external tank and solid rocket boosters, shown moving toward Kennedy Space Center's Launch Pad 39A during the early morning hours of rollout on Aug. 31. Shown below is the Columbia at the launch pad undergoing preparations for the Oct. 9 launch.



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Shuttle Launch Effects on Environment Examined

The launch of the first Space Shuttle mission on April 12, 1981, from the Kennedy Space Center, Fla., was the most completely investigated launch in the center's history from the standpoint of its impact on the local environment.

As stated in the Kennedy Space Center environmental impact statements, launch of the Space Shuttle produces a cloud of exhaust products which causes a temporary and localized degradation in air quality near the launch site areas. These areas are also subjected to moderately elevated sound levels of mostly low frequencies for a few minutes.

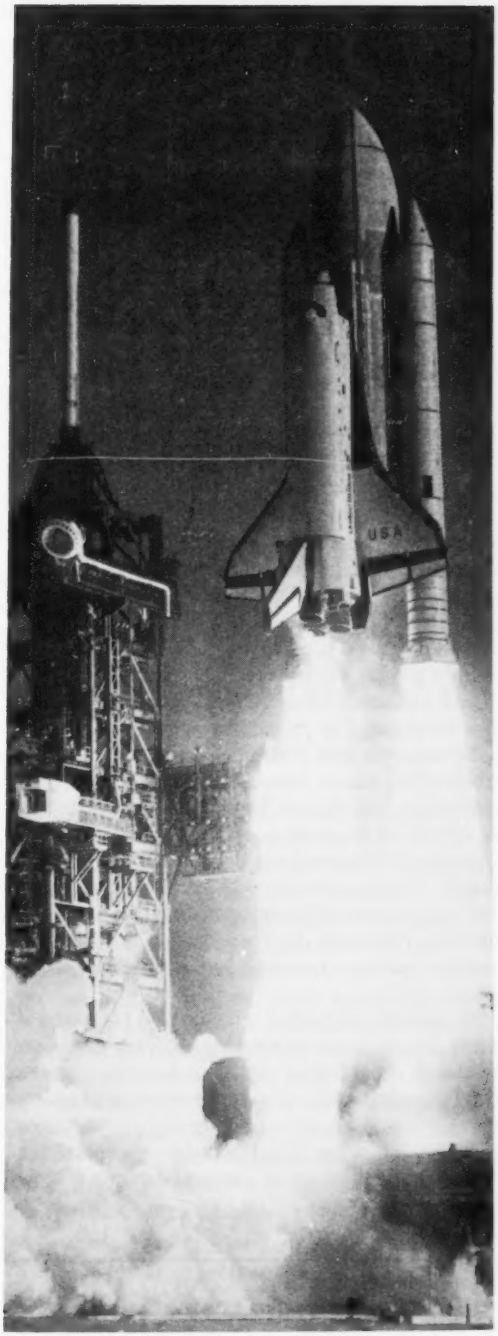
The direction, movement, and diffusion of the ground cloud have been the subject of an intensive analytical study during the past several years.

A mathematical model was developed which uses the characteristics of the rocket exhaust products and launch site meteorology to predict rise, growth, and dispersal of the ground cloud. To validate the model prior to STS-1, seven Titan launches were monitored at Kennedy using aircraft, ground, and seabased instrumentation to measure cloud concentration and fallout of hydrogen chloride and aluminum oxide particles. These are the primary exhaust products of the solid rocket motors which are of concern. In all cases, there was reasonable agreement between measurements and the model predictions.

As part of the first Space Shuttle launch operation, monitoring was performed on selected environmental areas to determine ecological effects. These effects were measured by a team of specialists drawn from NASA (Headquarters, Washington, D.C; Johnson Space Center, Houston; Langley Research Center, Hampton, Va.; Marshall Space Flight Center, Huntsville, Ala.; and Kennedy Space Center), the Merritt Island National Wildlife Refuge, the Canaveral National Seashore, the Air Force and several universities.

As predicted, the STS-1 ground cloud travelled north of the launch pad. Hydrogen chloride and dust from the exhaust cloud were measured with a variety of instruments both at ground level and inside the cloud, using an aircraft. Gaseous hydrogen chloride concentrations measured at the surface were essentially zero.

Airborne concentrations ranged from 16 parts per million (ppm) peak at 10 minutes to 2 ppm at 2 hours after launch, levels which are not considered excessive. Aluminum oxide dust was deposited from



The first launch of the Columbia, April 12, Kennedy Space Center, Fla.

the cloud in areas several miles to the north of the launch pad. Close to the pad, the dust was acidic and caused some localized spotting of vegetation. The area affected by the dust deposits did not exceed four miles in any direction.

Sound levels from the launch were measured at 111 decibels at about three and a half miles from the launch pad. These levels are similar to those produced by passage of a large truck nearby and about 10 decibels less than the sound level experienced at a rock music concert. These levels are very close to the predicted values and are similar to the sound produced in the Apollo launch program. No significant effects on wildlife behavior were observed by U.S. Fish and Wildlife Service personnel.

For STS-2, a more detailed study is planned of the particle fallout from the cloud by aircraft and additional ground collectors to obtain samples. Also, the model used prior to launch to predict cloud travel will be modified to predict the location of maximum dust deposits. Based on more than 12 years of meteorological data, fall winds occur predominantly from the east to northeast. Deposition is not expected to be a problem in areas of the community surrounding the center, based upon the STS-1 experience and the extensive prelaunch studies.

Until additional information is collected, precautions are planned to protect the public who come onto the center to view the launch from any unforeseen effects of the launch cloud. The visitor locations northwest of the Vehicle Assembly Building and in the vicinity of the barge basin south of the Vehicle Assembly Building will not be used during the STS-2 launch. Visitor operations will be centered on the NASA Causeway between Kennedy Space Center and Cape Canaveral Air Force Station and other locations outside a four-mile radius of the launch pad.

The launch cloud effect will not be a launch constraint. An extensive monitoring program emphasizing launch cloud fallout will be undertaken for the STS-2 launch in order to enhance the capability to predict the cloud direction, movement and diffusion. An evaluation of the STS-1 data for determination of any long term effects is continuing.

NASA Center Support for STS-1: A Reflective Look

They may not have shared the limelight with the Kennedy Space Center, the Johnson Space Center and the Dryden Flight Research Center, but NASA centers nationwide made invaluable contributions to the success of the first Space Shuttle flight.

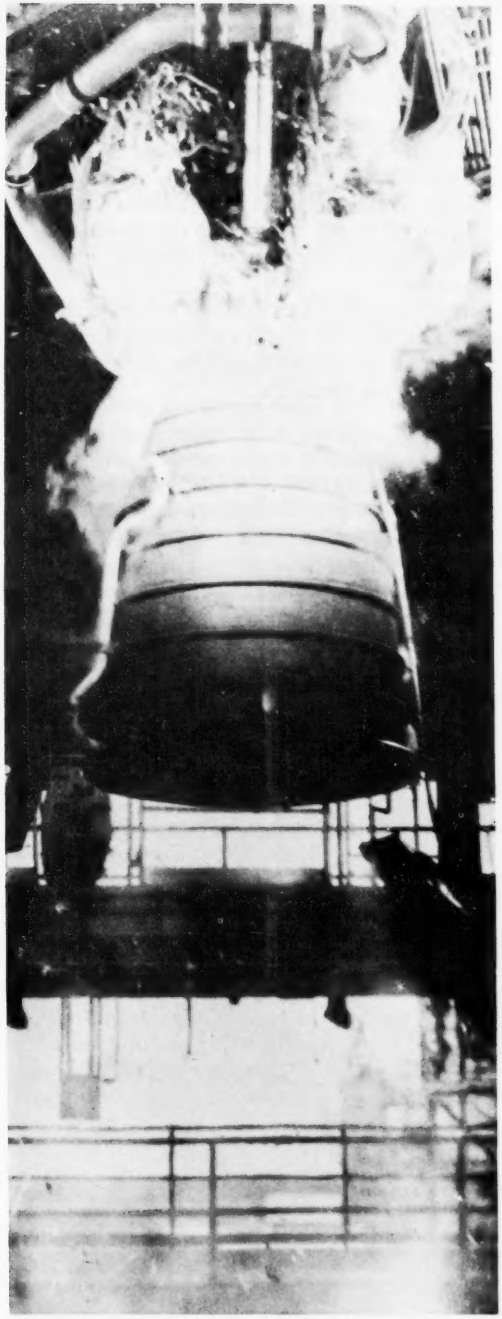
Goddard

Goddard Space Flight Center, Greenbelt, Md., is responsible for the worldwide tracking and communications network that provides the vital link between the spacecraft and the ground and between tracking stations. The center receives all telemetry, radar and air-to-ground communications and relays the information to the other NASA centers.

Goddard's far-flung network of 17 tracking stations, along with a Defense Department station in the Indian Ocean, provided communication between the astronauts and ground controllers, kept track of the spacecraft's position and acquired data on everything from the heartbeats of the crew to the temperature of Columbia's cabin.

The center also served as a backup mission control in case mission control at the Johnson Space Center in Houston suffered technical difficulties.

The Shuttle Enterprise is hoisted up the side of the vibration test facility at Marshall. Solid rocket boosters, filled with inert propellants, are stacked in the stand along with the orbiter and tank. Information from these tests allowed Marshall to verify system design and predict vibration response during launch and flight.



Space Shuttle main engine 0004, a developmental test model during its first firing at NASA's National Space Technology Laboratories in Mississippi.

Marshall

In Huntsville, Ala., the Marshall Space Flight Center developed and tested the Shuttle's liquid-fueled main engines, its solid rocket boosters and the external tank, all of which performed flawlessly on the first flight.

One critical test series performed at Marshall was the year-long Mated Vertical Ground Vibration Tests where various Shuttle configurations were checked to determine how its control systems and structures would react to the vibrations of flight.

Marshall also has responsibility for tests of the Shuttle main engines conducted at NASA's National Space Technology Laboratories, Bay St. Louis, Miss.

Center experts also worked on systems engineering and integration, determination of ground and flight operations requirements, development and integration of systems common to more than one Shuttle element and other special tasks.

The crucial tests of the Space Shuttle main engines were conducted at the Bay St. Louis facilities. Engines, both individually and in clusters of three, accumulated thousands of seconds of firing time. The tests all contributed to fine tuning of the engine system that performed so well on the first flight.

Ames

The largest single contribution made by the Ames Research Center, Mountain View, Calif., to the success of the Shuttle was the 40,000 hours of testing conducted in the facility's wind tunnels. The extensive test programs were designed to measure the forces, moments, pressure distributions and heating rates on all facets of the orbiter.

Another vital effort of the center was development and testing of the thermal protection system tiles that shielded the Shuttle from the searing heat of reentry into the Earth's atmosphere.

Sophisticated flight simulators at Ames helped give astronauts and engineers a sense of how it looks and feels to fly a Space Shuttle landing approach.

Other Ames' contributions to Shuttle included flight simulation, centrifuge tests and rocket exhaust studies.

Lewis

NASA's Lewis Research Center, Cleveland, Ohio, developed critical components of the Shuttle's fuel cells. The center's innovative development of a new catalyst for fuel cell use saved money and weight.

Technology developed and advanced at Lewis contributed to the design and engineering of the sophisticated Space Shuttle main engines.

Models of the Space Shuttle were tested in Lewis wind tunnels to provide data on the aerodynamics of the solid rocket boosters after separation and on the the entire Shuttle in launch configuration. Also obtained were airspeed and angle of attack data, base heating studies of the launch configuration and data on airflow and radiated heat transfer.

Wallops

The Wallops Flight Center on the Eastern Shore of Virginia provided launch and orbital support for the Shuttle flight. Wallops tracked the spacecraft and transmitted data to the Kennedy and Johnson Space Centers. The data included range safety commands relayed to the spacecraft and verbal transmission of computer generated impact prediction data to Kennedy for the launch phase of flight.

The center also launched meteorological rockets and radiosonde balloons to collect information to correlate with Shuttle sensor measurements.

Langley

The Langley Research Center, Hampton, Va., began studies of Shuttle concepts as early as 1966 and continued its support of design studies throughout development of the spacecraft.

The center is also involved in payload development and will supply several different experiments for future Shuttle flights. It also conducts studies of the impact of Shuttle launches on the atmosphere and the impact of Shuttle reentry noise on those on the ground.

Langley contributed to solutions for the problems encountered with the Shuttle's thermal protection system and is conducting ongoing studies of alternate systems for future use.

Headquarters

Coordinating the work of all of the centers, NASA Headquarters, Washington, D.C., provides overall management guidance and policy direction for the program.

Vintage Pilots—STS-2 commander Joe E. Engle (right) and his son John prepare to hand start their World War II L-4 vintage airplane. The Engles refurbished the plane to its original condition. Sending the serial number to the National Air and Space Museum, they received information on the plane which enabled them to recreate the aircraft in exact original detail including the plane's paint scheme.

NASA-NTIS Effort Gets High Technology to American Industry

Since 1964 when NASA concluded a formal agreement with the National Technical Information Service (NTIS) of the U.S. Department of Commerce, American industry has had access to a tremendous range of NASA scientific and technical research.

"NASA provides about nine percent of all the technical reports in our data base of 1,300,000 reports," said NTIS Director, Melvin S. Day. "From NASA programs we get consistently excellent technical reports which we include in a variety of our information products. It means that more taxpayers are able to make direct use of current technology researched or compiled by this important federal agency and, in so doing, gain an additional dividend from the nation's investment in its exciting aerospace program."

Abstracts of NASA reports are to be found in each of the 25 *Abstract Newsletters* which make their way to NTIS clients every two weeks. A 26th newsletter, entitled *NASA Earth Resources Survey Program* is mailed from NTIS bimonthly and is entirely composed of NASA report briefs covering such topics as minerals, vegetation, atmospheric conditions, environmental changes and more.

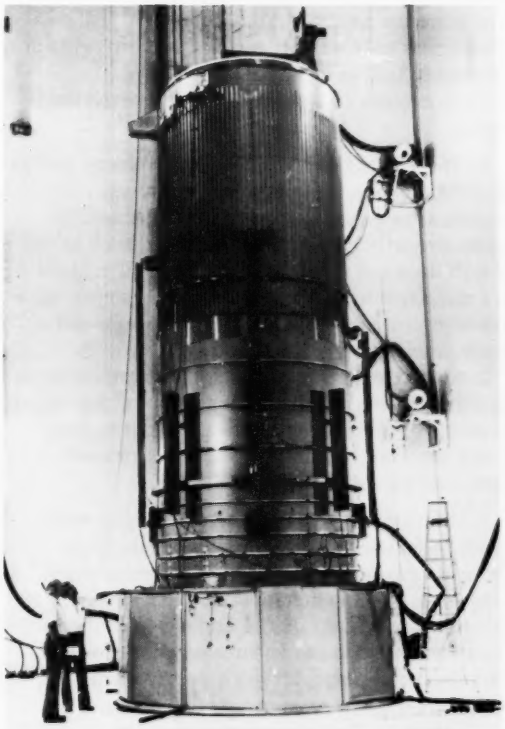
NTIS *Tech Notes*, which provides single-page analyses of new applied technology, depend upon the contributions made by NASA *Tech Briefs*, the information product that served as a model for *Tech Notes*. Scientific and technical reports from NASA may also be found by searching the monthly NTIS publication, *Government Reports Announcements & Index*, or by a computer search of the NTIS bibliographic data base.

Other NTIS products which include NASA reports are the biweekly series, *Selected Research in Microfiche*, offering subscribers full-text reports; and the single-topic bibliographic compilations called *Published Searches*, which contain informative abstracts.

Of the over 250 reports NTIS receives from NASA every two weeks, approximately half are reports of current foreign technology. NASA's reciprocal agreements with space centers in other parts of the world ensure American industry of receiving the latest available technological information in the many areas of aeronautics and space research.

NTIS, which serves as a central clearinghouse for U.S. Government sponsored research and development finds its job made easier because of the cooperation and assistance of agencies such as NASA. Just as NTIS has responsibility for the public sale of NASA publications, so it has the same responsibility to more than 350 other federal agencies. A total of 70,000 scientific and technical reports enter the NTIS data base annually as a result of research and development performed in the labs of federal agencies or their contractors. Further, NTIS supports itself entirely with the proceeds of the sale of technical information.

Anyone who wishes to obtain further information on reports available through NTIS products and services is encouraged to request, free of charge, the *NTIS General Catalog of Information Services.* Simply write to NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Va. 22161.



Vibration Testing—Full-scale acoustic test specimen representing the Space Telescope's Support Systems Module (minus aft shroud) shown in an acoustic chamber at the Lockheed Missiles and Space Co., Sunnyvale, Calif., following acoustic vibration tests. The tests simulated acoustic vibrations expected to be experienced by the unit inside the Space Shuttle cargo bay during launch.

NASA Satellite Helps Airlines Avoid Ozone Concentrations

Satellite data may help airlines avoid heavy concentrations of ozone. Encouraging results have been reported from an initial experiment which utilized information transmitted from NASA's Nimbus-7 spacecraft.

Ozone, which can be encountered by airliners at high altitudes, has caused shortness of breath as well as eye, nose and throat irritation among some airline passengers.

The two-month experiment, begun in March, was conducted jointly by NASA, the Federal Aviation Administration, the National Center for Atmospheric Research and Northwest Airlines.

In the test, information from Nimbus-7's Ozone Mapping Spectrometer was transmitted to NASA scientists at Goddard Space Flight Center, Greenbelt, Md. Here the data was processed and relayed within three hours to Northwest Airlines meteorologists in Minnesota for use in weather forecasting.

Early analysis of the results from the experiment shows:

1. The Total Ozone Mapping Spectrometer profile of total ozone in the atmosphere accurately represents upper air patterns and can be used to locate or verify meteorological activity, such as trough lines and rapidly moving fronts. The latter are associated with clear air turbulence; improved knowledge of their location over the oceans can assist airline pilots to avoid them.
2. Route forecasting of highly concentrated ozone appears feasible because the tests showed that higher amounts of ozone in aircraft were found in areas where the Total Ozone Mapping Spectrometer measured high total ozone amounts.

Additionally, five research aircraft flights were flown in jet stream regions located by the Total Ozone Mapping Spectrometer to determine winds, temperatures, and air composition at as many as 10 different flight levels. Initial findings from these flights showed that the jet stream pattern coincides with the area of highest total ozone gradient.

Low total ozone amounts are found where tropospheric air has been carried along above the tropopause on the anticyclonic side of the subtropical jet stream.

NASA Mathematician Solves Major Computer Imaging Problem

A problem that confounded computer graphics experts since the technology of computer-aided designing began, has been solved by mathematician David Hedgley of NASA's Dryden Flight Research Center, Edwards, Calif.

Hedgley's efficient and effective solution is a new computer program which can be applied to computer-graphic designing of any solid objects and surfaces regardless of complexity, including automotive design, architecture, metallurgy and anything that can be expressed as a function of two variables.

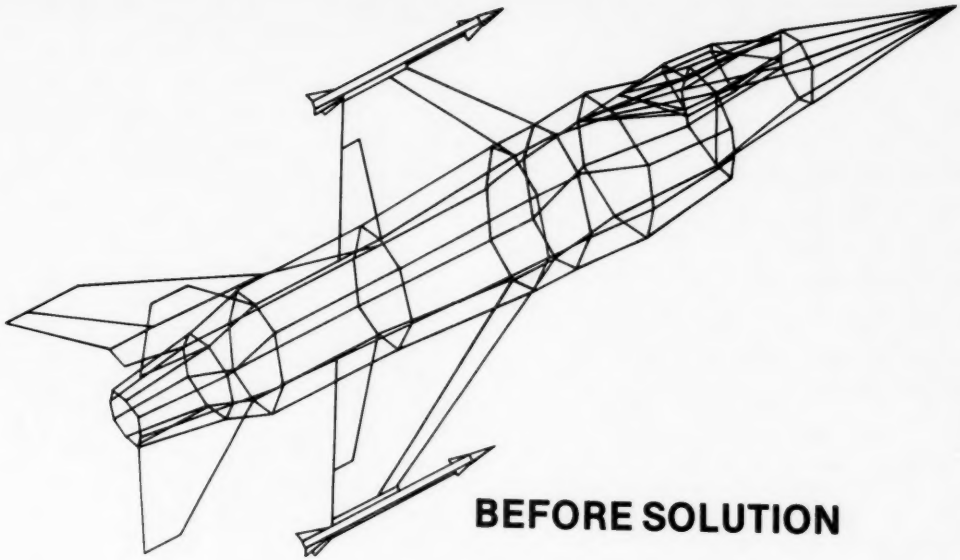
The problem was that a computer does not "see" a solid object the way a human sees it. The computer defined the whole object at once without regard to one particular or perspective. Consequently, when asked to produce a picture of the object, the computer would show all the object's surfaces, angles, and curves regardless of whether they are located on the side facing the viewer or on the back, which the eye cannot see. This resulted in cluttered, confusing and ambiguous pictures.

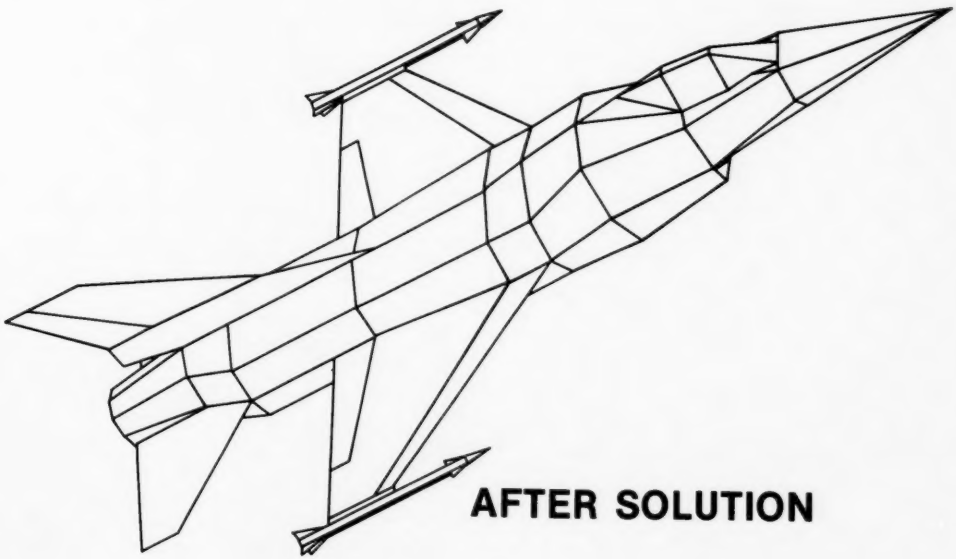
Hedgley's solution permits the computer to depict an object from a specific viewpoint just as the eye would see it, and does so efficiently. Furthermore, the solution works with any object or group of objects, no matter how complex.

Mathematicians around the world have worked the problem for years. Some achieved partial solutions. But until Hedgley's new program, none could be applied to any three-dimensional scene and few were reliably accurate. In fact, specialists considered the hidden-line problem to be the most difficult in the field.

Hedgley's program has just undergone computer testing at Lawrence Livermore Laboratory in California by experts Bruce Brown and Steve Levine. The test verified the solution's workability with respect to speed, accuracy and generality to all cases. Brown and Levine found the speed to be surprisingly high. Previous solutions broke down when dealing with complex scenes because execution time increased with the square of the number of polygons. Hedgley's solution avoids this problem, so it is not hampered when rendering complex objects.

Dryden researchers are starting to use Hedgley's solution in aircraft experimentation. They are finding it highly effective for analyzing wing flutter problems in unsteady aerodynamics. In addition, they have begun creating simple structures on small





computers and expect to expand this into simulated aircraft flight—a task requiring a more sophisticated computer. Such simulated flight will enable a pilot to practice chasing a synthetic target airplane by watching the image on a TV-like cathode ray tube. Speed becomes an essential ingredient in this sort of exercise where the program must be executed rapidly.

Device Helps Brain-Injured Children Learn to Crawl

At four years, Andrew took 16 hours to crawl one foot. Francesca, at 10 years, in eight hours could crawl only approximately 13 feet. Andrew and Francesca have brain injuries. The problems of weight-bearing and friction, caused by gravity, often prevent brain-injured children from being able to carry their own weight.

But Andrew and Francesca were given a second chance. A special device, created by Hubert ("Vic") Vykukal at NASA's Ames Research Center, Mountain View, Calif., reduces the barrier of friction, thereby giving certain disabled children a chance to reprogram their brains to crawl. Vykukal had previously developed frictionless devices for NASA to simulate the motions of satellites in space.

Andrew, after spending one month on the crawling aid, was able to crawl approximately 16 feet in 25 minutes on his own. Francesca, after seven months, could crawl 140 feet in four hours.

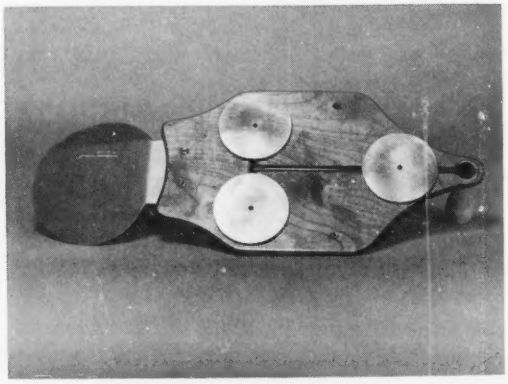
The Vehicle for Initial Crawling, or VIC device (named for its developer), consists of a rounded piece of plywood large enough to support the child's torso. Three aluminum discs fastened to the bottom of the plywood allow the device to glide along a smooth floor on a cushion of air. The air-bearing surface is created by pumping air through holes in the aluminum discs. Straps attached to the device are placed over the child's shoulders, restraining him and, at the same time, causing the device to move with the child.

The crawling aid is close to the floor, giving the child the sensation of being on the floor. The child's legs and arms are free to move randomly. When the child makes a movement that causes him to move forward, he receives positive feedback as the device floats along the frictionless surface. This constant and immediate feedback of information to the brain encourages the child to repeat the movement, eventually recreating the normal neurological connection between the brain and the muscles, which was impaired by the injury.

As the child travels farther and farther on the device, he develops his arm and leg muscles as well as coordination. Once he can crawl 330 yards, he is then put on the floor alone, without the crawling aid. The child then switches back and forth, first using the device and then crawling on his own. Eventually, he no longer needs the device at all.

The crawling device is used as part of an overall rehabilitation program developed by the Institutes for Achievement of Human Potential in Philadelphia. Currently nine children are using the crawling aid: one each from Denmark, India and Japan, three from Italy and three from the United States. Three children have graduated from the device. Fifty devices, costing $110 each, have been built by a contractor for the Institutes.

In photo above, child learns to crawl on Vehicle for Initial Crawling Device. Air is pumped through the hose allowing the device to float on the formica floor like a puck in a air hockey game. Photo below shows the underside of the device. Air is pumped through the aluminumdiscs reducing friction.



NASA Researchers Testing New Technique to Measure Wind

Researchers at NASA are testing a new technique to measure which way the wind blows. The data collected from a special airborne laser should help scientists better understand storms, understand air pollution and harness wind energy.

As part of NASA's Severe Storms and Local Weather Research Program, a team of researchers spent this summer flying in Oklahoma, Montana, Colorado and California. Onboard with the researchers was a Doppler Lidar System, a special laser system built by Raytheon for NASA's Marshall Space Flight Center, Huntsville, Ala. The aircraft, a Convair 990, is a four-engine jet transport known as the Galileo II flying research laboratory. The aircraft was provided by NASA's Ames Research Center in Mountain View, Calif.

The Convair 990 flies at various altitudes near the edge of a storm. The lidar measures the velocity of minute aerosols (pollen and dust). Because these particles are so light, they travel at the same velocity as the wind. The lidar samples aerosol backscatter frequency variations with range and looks forward and back every 1 ½ seconds.

The interactions in space of the lidar beams create a grid pattern that is analyzed by a computer onboard the aircraft. The computer can calculate wind vectors based on the original frequency of the beam, the reflected frequency, the speed of the aircraft and other factors. These vectors give the direction and speed of the wind at each point of the grid in a horizontal plane next to the aircraft.

Onboard the aircraft, the computer gives an instant picture of the wind by plotting vector fields on a graphic display. Thus researchers can get a picture

By sending an airborne laser (Doppler Lidar System) into the air around a thunderstorm, scientists, based on the reflection of the beam from tiny particles in the air, hope to learn more about storms and air pollution and the harnessing of wind energy.

of the changes in the speed and direction of the wind in a horizontal slice of the atmosphere ranging from 985 feet to 12 miles from the plane, depending on the amount of aerosols in the air.

The laser beam poses no danger to anyone on the ground or in other aircraft. This laser system emits energy at levels of 10 to 100 times lower than the established eye safe level. The eye safe level, as established by the American Conference of Environmental Industrial Hygienists, is the amount of radiation an eye can be exposed to without injury.

The lidar system was used this summer in conjunction with the National Severe Storms Laboratory in Oklahoma and the Cooperative Convective Precipitation Experiment, based in Montana. The precipitation experiment, supported by a number of universities and government agencies, is designed to study how clouds produce rain, a question particularly important to drought-prone areas such as the High Plains in the West.

Data collected from the summer tests will be compared to data collected from other measurement systems, such as ground radar, towers and balloons, in order to test the accuracy of the new lidar technique. The project scientists, headed by Dr. George Fichtl from NASA's Marshall Space Flight Center, plan to combine data from all available sources to provide meteorologists with a more complete picture of what happens before and during storms.

Wind speed and direction also are important to meteorologists studying air pollution. The aircraft recently flew past various mountain passes in California to determine what happens to polluted air that is created in the San Francisco Bay area and Los Angeles regions.

"Air pollution is a severe problem in the Los Angeles area," said Charles Unger, state air pollution research specialist. "We need to know what happens to the pollutants—what are the sources, where do they go, how concentrated are they, whom they impact."

Unger is hoping that data from air balloons and ground radar systems together with the information from the airborne laser systems will help the state Air Resources Board to predict better when to restrict agricultural burning and when to rely on emergency pollution control measures.

The plane also flies low enough to gather data on the best location for wind turbines. Data of this type was gathered at the San Gregonio pass near Los Angeles. Southern California Edison, a utility company that has a wind turbine in this area is interested in the results of this data.

Landsat Imagery Monitoring California Crops

California agriculture is being monitored from space. NASA's Ames Research Center, Mountain View, Calif., and the California Department of Water Resources are testing the use of Landsat satellite imagery to inventory and map irrigated cropland.

During July and August, the middle of California's dry season, anything that shows up as red on Landsat color composite images indicates vigorous vegetation and may have been irrigated. Irrigated areas can then be separated from natural vegetation, such as that found along streams, through their spatial rather than spectral characteristics. That is, irrigated fields show distinctive shapes (usually blocked) and homogeneous texture as opposed to the irregular shapes of vegetation along stream beds and the mottled texture of forests.

NASA's two Landsat satellites can survey any spot on Earth every 18 days. Imagery of the state was chosen from three time periods in 1979: March and April, July and August and September and October. A multispectral scanner on each satellite records differences in sun reflectance from Earth-surface features.

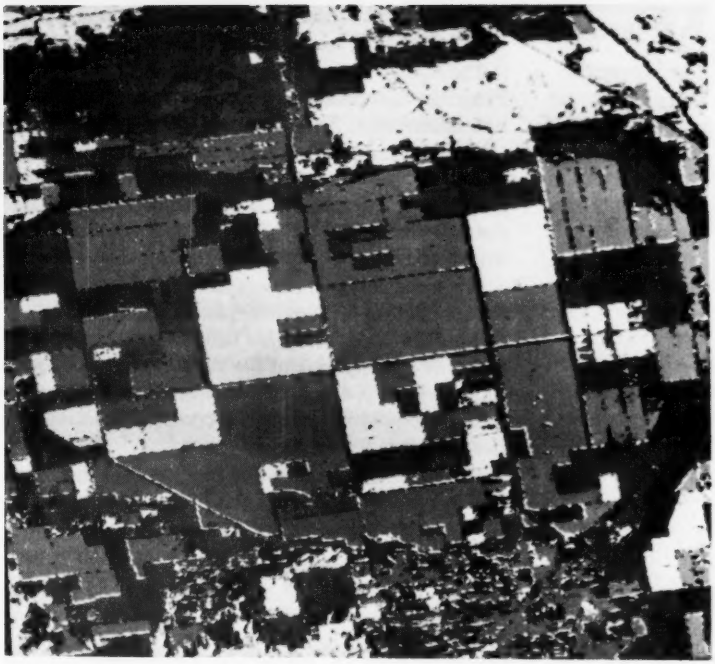
The scanner takes four readings for each 1.1 acre area on the ground based on the intensity of visible and invisible (infrared) light that is reflected. These intensity levels are converted to film and computer compatible tapes at stations on Earth.

Maps indicating which areas were irrigated were drawn from the satellite data. Since agriculture uses 85 percent of the state's water supplies, such maps can help in the Department of Water Resources monitoring of water use.

Currently the California Department of Water Resources conducts land use surveys, relying on aerial photography and data collected on the ground, that cover approximately one-seventh of the state each year. Thus the entire state is resurveyed about every seven years. A statewide analysis of Landsat satellite data, covering the entire state over one growing season, came within one-half percent of the water department's data. Besides confirming the department's data, the analysis also helped Ames researchers verify their techniques.

But Landsat is able to do more than confirm existing data. The satellite imagery is now being tested by the water department for use in monitoring early grains and double cropping.

Landsat data covering March through June are



Landsat multispectral signature of cultivated fields in California's San Joaquin Valley.

being used to catch the early grains. By comparing the data over the three time periods (March/April, July/August and September/October), the department also can tell whether more than one crop has been planted on any given acreage.

"California agriculture is so dynamic that it would be inadequate to look at just one date," Bauer said. "By summing up three timeframes, however, we can obtain a good estimate of total irrigated acreage."

Certain crops have what is termed a Landsat signature. A signature, which is determined by viewing the same area over time, shows distinctive coloring, or spectral reflectance, separating one crop type from another. For example, in the early part of the year, alfalfa and wheat both appear red. But in late May or June, the wheat has dried and appears bright yellow. The irrigated alfalfa continues its red appearance on the satellite imagery.

The satellite is now monitoring four counties—Kings, Yolo, Glenn and Butte, to determine how much early wheat is being grown.

More than 200 different crop types exist in California. Some crops are difficult to distinguish by satellite. At certain growth stages they are hard to tell apart when you drive past them 10 feet away. Furthermore, crops covering less than 10 acres are hard to pick up by satellites traveling at 570 miles altitude.

However, the Department is hoping to monitor 90 percent of the crop acreage. Generally, in each of the 10 hydrologic regions that comprise the entire state, 20 or 30 crops are grown. Typically, approximately 10 of those crops cover 90 percent of the area.

The project relied on Ames research staff, personnel from the state Department of Water Resources and remote sensing experts from the University of California at Berkeley and Santa Barbara, and Technicolor Graphic Services. More than 10 million acres were surveyed by the satellite, and 1¼ million acres of ground sample data acquired by the California Department of Water Resources were used to verify the satellites' information.

Landsat orbits the earth 14 times each day at an altitude of about 570 miles. The first Landsat was launched in 1972 and, though only expected to function one year, continued providing information until January 1978. Landsat-2, still functioning, was launched in January 1975; Landsat-3 was put into orbit March 1978. A fourth and more technically advanced Landsat is scheduled for launch in mid-1983.

Astronaut Candidates Complete Training

Nineteen NASA astronaut candidates and two European Space Agency (ESA) mission specialist candidates have completed the first phase of their training at the Johnson Space Center, Houston.

The 19 Americans become full-fledged members of the U.S. astronaut corps, which now totals 79. Their training will continue toward qualifying them for duties as pilots or mission specialists on future flights of the Space Shuttle. They began training in July 1980.

The new American astronauts are: Dr. James P. Bagian; Lt. Col. John E. Blaha, U.S. Air Force; Maj. Charles F. Bolden Jr., U.S. Marine Corps; Lt. Col. Roy D. Bridges Jr., U.S. Air Force; Dr. Franklin R. Chang; Dr. Mary L. Cleave; Bonnie J. Dunbar; Dr. William F. Fisher; Maj. Guy S. Gardner, U.S. Air Force; Maj. Ronald J. Grabe, U.S. Air Force; Capt. David C. Hilmers, U.S. Marine Corps; Lt. Cmdr. David C. Leestma, U.S. Navy; John M. Lounge; Maj. Bryan D. O'Connor, U.S. Marine Corps; Lt. Cmdr. Richard N. Richards, U.S. Navy; Capt. Jerry L. Ross, U.S. Air Force; Lt. Cmdr. Michael J. Smith, U.S. Navy; Maj. Sherwood C. Spring, U.S. Army; and Lt. Col. Robert C. Springer, U.S. Marine Corps.

NASA last year agreed to include two European scientists in the astronaut training program in recognition of the substantial contribution ESA is making to the Space Transportation System by funding development of Spacelab. ESA is reimbursing NASA for the costs of training the two Europeans.

ESA has indicated it will decide soon which of the two Europeans will transfer to NASA's Marshall Space Flight Center in Huntsville, Ala., for payload specialist training in preparation for the first Spacelab flight. The other will continue training as an ESA astronaut at Johnson for possible selection as a mission specialist for missions carrying European payloads aboard the Shuttle. The two Europeans are Dr. Claude Nicollier of Switzerland and Dr. Wubbo Ockels of the Netherlands.

NASA Study Shows Weather Data System Could Trim Jet Fuel Costs

With little more than fine tuning of global weather forecasting apparatus, the worldwide commerical airline industry could realize upwards of $1 billion in annual fuel savings according to a NASA study. This is a preliminary conclusion of recent 20-month study at NASA's Lewis Research Center in Cleveland.

The NASA Commerical Aircraft Fuel Savings Program was conducted in cooperation with the Federal Aviation Administration (FAA), the National Oceanic and Atmospheric Administration (NOAA), the governments of Canada, Great Britain and the Netherlands, and a number of international commercial airlines including KLM, TWA, Delta, British Airways, Swissair, SAS and VIASA.

When the cost of fuel was low and a minor factor for commerical airlines, completely automated weather forecasts with their broadbrush approach and wide-ranging look at the weather were good enough. But the awesome leap in the cost of fossil fuels since 1974 has caused all concerned to take a closer look at the subject.

The government-sponsored program has shown that many long distance flights are planned on old weather data; and much of the data is too broad to pinpoint the location and intensity of important upper air jet streams and regions of sharp temperature gradients.

At present, the commercial aviation industry spends between $36 and $40 billion annually for fuel, more than 40 percent of the airlines' overall operating expenses. Whether a multi-engine jet aircraft bucks a stubborn headwind or is assisted by a favorable tailwind can make an enormous difference in fuel consumption. Jet engines also generally used fuel more efficiently in colder air.

At present, worldwide weather information is gathered mainly in four ways: by satellite observation; from weather-sensing balloons launched over land masses; from in-flight pilot reports; and from ships.

This information is assembled automatically, fed into computers and called up at will for flight planning purposes. But such information is based usually on weather observations taken at 12-hour intervals and airlines most often plan their long distance flights on an 18 to 24 hour forecast. However, the weather, particularly over oceans, can change drastically in a 6 to 12 hour period.

Demonstrating the impact of wind on fuel economy, a commercial jet airplane traveling at 500 miles per hour can cover 1,000 miles in 120 minutes. But burdened with a 150-mph headwind, the plane's flight progress would be reduced to 350 mph and it would require 171 minutes to cover that same 1,000 miles. Conversely, aided by a favorable 150-mph tailwind, the plane's progress would be increased to 650 mph and it would require only 92 minutes to

travel 1,000 miles.

A B-747 commercial jet consumes 3,600 gallons of fuel per hour or 60 gallons per minute. Thus, the 1,000 mile "headwind" flight would consume 10,260 gallons of fuel, while the "tailwind" flight would require only 5,520 gallons, saving almost half or 5,040 gallons at $1 per gallon. Multiply these calculations by the 400 to 500 commercial jet flights across the North Atlantic in a 24-hour period during the summer months and the potential for either waste or savings becomes clear.

Thus for fuel efficiency in long-haul, commercial aviation flight planning: find the jet stream; find the tailwind; find the coolest air. And this can only be done with more frequent weather observations, in greater detail, subject to human evaluation.

Astronaut Fred Haise Resigns

Astronaut Fred W. Haise resigned from NASA in June to join Grumman Aerospace Corp., Bethpage, N.Y., as Vice President for Space Programs.

Haise's NASA career started as an aerospace research pilot at Lewis Research Center, Cleveland, in 1959. This was followed by three years at the Dryden Flight Research Center in California. Haise was one of the 19 astronauts selected by NASA in April 1966.

He was lunar module pilot for Apollo 13, April 11-17, 1970. The flight was to be a 10-day flight landing in the Fra Mauro region of the moon; however, the flight plan was modified enroute to the moon due to a failure of the service module cryogenic oxygen system, approximately 55 hours into the flight.

Haise, and fellow crewmen, James A. Lovell and John L. Swigert, working closely with Houston ground controllers, converted their lunar module into a lifeboat. Their emergency activation and operation of the lunar module systems conserved both electrical power and water in sufficient supply to assure their safe return to Earth.

Haise was backup lunar module pilot for the Apollo 8 and 11 missions and was backup spacecraft commander for the Apollo 16 mission.

From April 1973 to January 1976, he was technical assistant to the manager of the Space Shuttle Orbiter Project.

Haise was commander of one of the two 2-man crews which piloted Space Shuttle Orbiter Approach and Landing Test flights during the period June through October 1977. He was named in March 1978 to command one of the early Shuttle Earth Orbital Test Flights.

EPA Approves Space-Age Sewage Treatment System

NASA research over the past 10 years has led to the development of a simplified natural biological sewage treatment process. The system recently has been approved by the Environmental Protection Agency for treating municipal sewage.

This unique wastewater treatment system, developed by Dr. Bill Woverton at NASA's National Space Technology Laboratories, Bay St. Louis, Miss., is odor free and costs less than half as much as a conventional system to operate and maintain.

It combines the oldest of wastewater treatment systems (septic tanks and trickling filters) with space-age technology in anaerobic filter and vascular aquatic plant wastewater treatment. The result is a hybrid wastewater treatment system where microorganisms which live or are active only in the presence of oxygen (aerobic), those which live or are active in the absence of oxygen (anaerobic), and facultative (a combination of the two) are balanced in a high surface area rock or vinyl core filter with vascular aquatic plants added at the aerobic side of the filter to completely balance the system and allow for wastewater recycling capability. The sewage or other type wastewater is never open to the atmosphere until treatment has been accomplished.

The odorous substances normally produced with domestic sewage during the anaerobic digestion phase are converted to nonodorous substances and finally into plant biomass at the end of the filtration column. The addition of harvestable plants (reeds, cattails, etc.) to the microbial filter system not only increased the capacity of this system for removing resistant organics such as PCBs, but adds the capability for removing chemical elements.

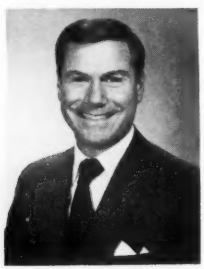
This hybrid system, which was unveiled to the public for the first time in March 1981, has already been used by an engineering firm in Baton Rouge, La., for designing two wastewater treatment plants to be located at Minden and Tallulah, La.

John Murphy Named to Legislative Post at NASA

John F. Murphy was named Director of Legislative Affairs at NASA effective Sept. 8, replacing Terence T. Finn, who was appointed Deputy Director of Government/Industry Affairs. Patrick A. Templeton was appointed Deputy Director of Legislative Affairs.

Murphy came to NASA from the Agency for International Development where he was Director of Legislative Affairs since March 1981. From 1974 to that time, he served as Administrative Assistant to Sen. Barry Goldwater (R-Ariz.). He had been Deputy Director of Communications (Public Affairs) for the Department of Interior from 1972 to 1974 and worked for the U.S. Information Agency in Saigon, Vietnam, as a senior television advisor from 1969 to 1972.

He attended Phoenix College, the University of Arizona and the University of California, NBC Radio Institute. He and his wife, Mary, make their home in Washington, D.C.



Before joining NASA, Templeton was employed by the General Electric Co., where he was manager of government and community relations for the Major Appliance Business Group. He began work with General Electric in 1965 in the Sales Management program. He had been manager of Government Relations for General Electric's Transportation and Communications Systems Division in Washington, D.C.

Templeton has a B.S. degree from the Georgetown University School of Foreign Service. He and his wife, Charlotte, have two children and reside in Bethesda, Md.

Awards Corner

A. Thomas Young, Director of Goddard Space Flight Center, Greenbelt, Md., received an **Advocate of the Year Award** presented by the Small Business Administration's Philadelphia District for Goddard's leadership role in contracting to small and minority businesses in 1981. This award is given to agencies which show outstanding support for the success of the small business community in the states of Pennsylvania, Delaware, Maryland, Virginia, West Virginia, and the District of Columbia.

Donald P. Hearth, Director of Langley Research Center, Hampton, Va., was presented a **Certificate of Appreciation and the Yorktown Medal** from York County Board of Supervisors and the York County Administrator. The Center was commended for "its contributions to the Space Shuttle, the nation and the community and for its example as a good neighbor to the County of York."

Ernest L. Rowe, former Assistant Chief of the Operations Support Division at NASA's Langley Research Center (now a retiree), **Roy A. Heath, Jr.**, of the Personnel Division, and **William M. Phillips, Jr.**, Chief of the Fabrication Division, have received **Langley's Equal Opportunity Award** for the first quarter of fiscal year 1981. Each was cited for "significant achievement in equal opportunity through the initiation, development and implementation of programs which have made possible the hiring of minority and female technicians at Langley."

Robert C. Evans and Joseph F. Powers of Langley Research Center's Fabrication Division recently received the **largest Suggestion Award ever presented by Langley**. The $3,232 award, which was shared equally, was awarded for designing foam blocks for the National Transonic Facility Tunnel which resulted in a $72,000 savings to the government.

Hans Mark, NASA's Deputy Administrator, received the Air Force Association's **Theodore von Karman Award** for science and engineering at their 35th Anniversary Convention held in Washington in September. Mark was cited for "brilliantly marshalling scientific and engineering resources to expand and modernize the Air Force's capabilities in the strategic, tactical, and force projection areas." This award is named for Dr. Theodore von Karman, a world renowned expert in the field of aerodynamics.

NASA astronauts **John Young** and **Bob Crippen** were awarded **Air Force Association Special Awards** for their "pioneering flight in the spacecraft Columbia." This award is presented to honor events of exceptional achievement.

Richard Smith, Director of NASA's Kennedy Space Center, Fla., was awarded an **honorary doctor of science degree** at commencement ceremonies at Florida Institute of Technology on June 13.

Did You Know?

Compton Community College, Compton, Calif., is planning to develop a comprehensive Southern California Earth and Space Science Regional Center. It will feature an observatory, a planetarium, an earth science museum and a space science museum. The college is interested in obtaining the temporary services (assignment under the Intergovernmental Personnel Act) of a NASA scientist to assist in both the conceptual development and in the implementation planning of the center. If interested, contact Ronald Chatman, (213) 635-8081, ext. 317, for additional information.

A formal program to publish Langley's history is now underway and NASA employees and retirees can help document the history of this center's more than 60 years of aeronautical achievements. Dr. James R. Hansen, who recently received a doctorate in history from Ohio State University, has been commissioned by the NASA History Office in Washington, D.C. to write a book on the "History of NACA-Langley, 1917-1958." Hansen began his 38-month stay at Langley June 15 and has begun interviewing people who were at NACA-Langley during those years. NACA, the National Advisory Committee for Aeronautics, was NASA's predecessor agency. NASA employees and retirees who know of or have any Langley historical documents or artifacts dating from 1917 to 1958 should call Hansen, (704) 827-3307, or Richard Layman, Langley's Historical and Artifacts Program Coordinator, (804) 827-3511.

James A. Downey, III, has been appointed manager of the Spacelab Payload Project Office at NASA's Marshall Space Flight Center, Huntsville, Ala., effective July 20. He replaced O. C. Jean, who retired. In his new position, Downey will head the office responsible for managing missions of Spacelab, the reusable laboratory that will be flown aboard the Space Shuttle beginning in 1983. For the past five years, Downey has been deputy director of the Program Development Directorate, the center's focal point for defining future space missions and systems and for studying special applications of space technology. He has been a member of the Marshall Center and its predecessor organizations since 1958.

Dr. Arnauld Nicogossian, NASA Headquarters Medical Operations Officer, Life Sciences Division, has been selected as president-elect of the Northern Virginia Chapter of the American Heart Association for 1981-82.

The 24th Israel Annual Conference on Aviation and Astronautics will be held in Israel on Feb. 17-18, 1982. The conference program will include invited lectures and contributed papers in the subjects of aeronautical design, aerodynamics, aircraft structures and aeroelasticity, structural dynamics, combustion and propulsion, flight control, guidance and navigation, aerospace applications of differential games, astronautics and flight operations and systems. Accepted papers will be published in the conference proceedings as a special issue of the Israel Journal of Technology. For further details contact: The Secretary, Organizing Committee, 24th Israel Annual Conference on Aviation and Astronautics, c/o Department of Aeronautical Engineering, Technion—Israel Institute of Technology, Haifa, 32000, Israel.

Contractor News

Boeing Services International, Inc., Kennedy Space Center, Fla., has been awarded a supplemental agreement to an existing contract with NASA's Kennedy Space Center to handle supply and transportation services at the center and adjacent Cape Canaveral Air Force Station. The value of the cost-plus-award-fee agreement is $13,545,786, and brings the aggregate contract value to $41,435,032. The one-year supplemental contract covers the period from July 1, 1981 through June 30, 1982. The supply functions include operations at the Central Receiving Facility and various supply warehouses located throughout the two installations. Transportation functions include handling outgoing shipments for NASA and contractor organizations from Kennedy and Cape Canaveral Air Force Station. The new award represents the fourth year of service under a contract for one year plus four one-year options.

Datacom Inc., Fort Walton Beach, Fla., has been selected for negotiation of a contract by NASA's Langley Research Center, Hampton, Va., in support of a new Avionics Integration Research Laboratory at Langley. The contract calls for systems design and for furnishing and installing computer and other equipment for the new laboratory. The fixed price contract will run for a period of three years and is valued at approximately $4.6 million. Researchers

will be able to simulate an entire avionics system for a transport aircraft, using simulators, analytical modeling, experimental hardware and software, and detailed techniques of assessment.

Pan American World Airways, Inc., Aerospace Services Div., Cocoa Beach, Fla., has been awarded a one-year extension of its contract by NASA's Kennedy Space Center, Fla., to supply medical services at the center and Cape Canaveral Air Force Station. Under the contract, Pan American will provide occupational medicine and environmental health services to civil service, military and contractor personnel. Services are provided by physicians, medical technicians and nurses in facilities at Kennedy and Cape Canaveral Air Force Station. The $3,573,338 award covers the period July 1, 1981, through June 30, 1982, and brings the cumulative value of the contract since July 1, 1977 to $12,372,535. The new award marks the fifth year of service under a contract with a one-year basic term plus four one-year options.

Martin Marietta Corp., New Orleans, La., has been awarded a revision of an existing contract by NASA's John F. Kennedy Space Center which will accelerate work on processing the Space Shuttle's external tank. The contract revision is worth $3,482,302 and brings the aggregate value of the parent contract to $41,409,577. The revision covers the period October 31, 1980, through March 31, 1982, running concurrently with the existing contract. The revision will support more than 40 additional workers needed to extend work shifts to a round-the-clock schedule. Almost 300 workers are employed in processing operations on the external tank under the original contract. Martin Marietta is the prime contractor for the external fuel tank of the Space Shuttle, the only major shuttle flight element that is not reusable.

Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Israel Taback, Bionetics Corp., Hampton, Va.	Small conductive particle sensor	4,286,209	LaRC
Lana M. Couch, NASA/LaRC	Wind tunnel supplementary mach number minimum section insert	4,286,460	LaRC
Jewell G. Belcher, Jr., and Ben R. Hollis, Jr., NASA/MSFC	Liquid immersion apparatus for minute articles	4,286,542	MSFC
Richard B. Hoover and Charles M. Rhodes, NASA/MSFC	Method of and means for retarding dye fading during archival storage of developed color photographic film	4,287,152	MSFC
Haynes Ellis, Jr., Rockwell International Space Systems Group, Downey, Calif.	Cavity-backed, microstrip dipole antenna array	4,287,518	JSC
Richard C. Heyser, Caltech/JPL, Pasadena, Calif.	Method for shaping and aiming narrow beams	4,287,578	NRO
Philip I. Moynihan and Donald L. Young, Caltech/JPL, Pasadena, Calif.	Fluidized bed coal combustion reactor	4,287,838	NRO
George F. Lutes, Jr. and Kam Y. Lau, Caltech/JPL, Pasadena, Calif.	Fiber optic transmission line stabilization apparatus and method	4,287,606	NRO
Larry L. Fewell, Harry R. Allcock, John P. O'Brien, and Angelo G. Scopelianos, Pennsylvania State University, University Park, Pa., and NASA/Ames	Carboranylcyclotriphosphazenes and their polymers	4,288,585	ARC
John David Kuenzly, TRW, Inc., Redondo Beach, Calif.	Low thrust monopropellant engine	4,288,982	GSFC
Martin L. Stevens, Fairchild Republic Co., Farmingdale, Long Island, N.Y.	Surface conforming thermal/pressure seal	4,290,612	JSC
Shaik A. Qader, Caltech/JPL, Pasadena, Calif.	Solar heated fluidized bed gasification system	4,290,779	NRO
Wendell D. Chase, NASA/ARC	Spectrally balanced chromatic landing approach lighting system	4,291,294	ARC

Expendable Launches for 1981

Name	Launch Date	Vehicle	Range	Mission Remarks
COMSTAR-D	February 21	Atlas Centaur	ESMC	Comsat General Corp. communications. Reimbursable.
Navy 20 (NOVA 1)	May 15	Scout	WSMC	DOD transit. Reimbursable.
GOES-E	May 22	Delta	ESMC	NOAA weather. Reimbursable.
Intelsat V-B	May 23	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
NOAA-C	June 22	Atlas-F	WSMC	NOAA weather. Reimbursable.
Dynamics Explorer	August 3	Delta	WSMC	NASA scientific.
FLTSATCOM-E	August 6	Atlas Centaur	ESMC	DOD communications. Reimbursable.
SBS-B	September 24	Delta	ESMC	SBS communicatons. Reimbursable.
Solar Mesosphere Explorer	October 3	Delta	WSMC	NASA scientific.
RCA-D	November 19	Delta	ESMC	RCA communications. Reimbursable.
Intelsat V-C	November 19	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Navy 21 (NOVA 2)	4th quarter	Scout	WSMC	DOD transit. Reimbursable.

Space Shuttle Launches for 1981

Orbiter	Launch Date	Launch Site	Payload
OV-102	April 12	KSC	.....
OV-102	Oct. 9	KSC	OSTA-1 DFI (with IECM)

Approach to Launch Pad—The Columbia nears completion of rollout to launch pad 39A, Kennedy Space Center, on Aug. 31.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

New Thermal Panels

Multiwall metallic panels now under development at NASA's Langley Research Center, Hampton, Va., as replacements for the ceramic-surface insulation tiles of the Space Shuttle could eventually be used in other aircraft and possibly even as thermal protection in ground-based applications.*

The new thermal protection system was conceived by L. Robert Jackson of Langley. Various configurations of the basic multilayer sandwich are expected to protect against temperatures ranging from 700° to 2,700°F (3700 to 1,480°C).

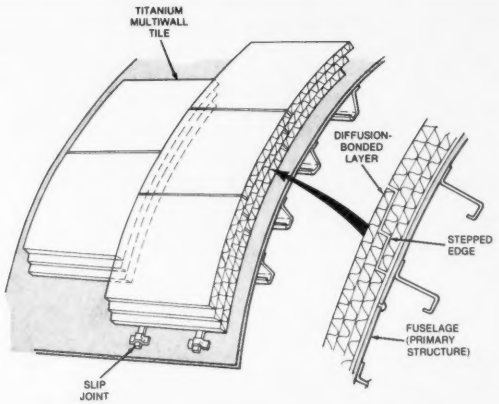
A major objective for the new panels is to survive the expected 100-mission lifetime of the Space Shuttle and to be more durable than the ceramic tiles which have to be carefully monitored for surface fraying, erosion and cracking. The new metal panels should withstand thermal and mechanical stresses better without adding to the weight of the vehicle.

Each panel attaches to the primary structure with a bayonet mounting at its corners (see figure). This simple slip joint allows for expansion to relieve thermal stress. Furthermore, each panel is isolated from the strains of the primary structure, with adequate space for thermal expansion and mechanical tolerances.

To prevent vibration, felt strips are compressed at the edges of the panels. Each panel is vented to the local static pressure through a hole in the felt strip at the trailing edge on the cooler surface.

The insulating panels have different structures, depending on the local temperature to be encountered. For the temperate range from 7000 to 900° F (370° to 480° C), multiwall metal (usually titanium) panels consist of alternating flat and dimpled sheets, joined at dimple crests as shown in the figure.

For the temperature range from 900° to 1,600° F (480° to 870° C), a metallic enclosure supports a fibrous insulating filling.



For the range from 1,600° to 1,900° F (870° to 1,040° C), the outer sandwich is a superalloy honeycomb sandwich; in the range of 1,900° to 2,200° F (1,040° to 1,200° C), the outer layer is a flanged waffle of oxidation-dispersion-strengthened alloy.

At 2,200° to 2,700° F (1,200° to 1,480° C), the outer layer is a coated refractory-metal-flanged waffle or a rib-stiffened advanced-carbon-carbon panel.

The basic technology required to produce the panels has been or is being developed, and models have been built. They await large-scale testing of assemblies on representative structures.

*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of such technology.

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For the benefit of all . . .

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